TECHNOLOGY TALENT ADVISORY COMMITTEE REPORT

December 2016

Commissioner Catherine H. Smith
Department of Economic and Community Development

Section 23. (Effective from passage) (f) The Technology Talent Advisory Committee shall, in the following order of priority, (1) calculate the number of software developers and other persons (A) employed in technology based fields where there is a shortage of qualified employees in this state for businesses to hire, including, but not limited to, data mining, data analysis and cybersecurity, and (B) employed by businesses located in Connecticut as of December 31, 2016; (2) develop pilot programs to recruit software developers to Connecticut and train residents of the state in software development and such other technology fields, with the goal of increasing the number of software developers and persons employed in such other technology fields residing in Connecticut and employed by businesses in Connecticut by at least double the number calculated pursuant to subdivision (1) of this subsection by January 1, 2026; and (3) identify other technology industries where there is a shortage of qualified employees in this state for growth stage businesses to hire.

(g) The Technology Talent Advisory Committee may develop pilot programs for (1) marketing and publicity campaigns designed to recruit technology talent to the state; (2) student loan deferral or forgiveness for students who start businesses in the state; and (3) training, apprenticeship and gap-year initiatives.

(h) The Technology Talent Advisory Committee shall report, in accordance with the provisions of section 11-4a of the general statutes, and present such report to the joint standing committee of the General Assembly having cognizance of matters relating to commerce, education, higher education and finance, revenue and bonding on or before January 1, 2017, concerning the (1) pilot programs developed to subsections (f) and (g) of this section, (2) number of software developers and persons employed in technology-based fields described in subsection (f) of this section targeted for recruitment pursuant to subsection (f) of this section, and (3) timeline and measures for reaching the recruitment target.

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This report is submitted in response to Section 23 of Senate Bill No. 502. This Bill requires the Technology Talent Advisory Committee, which exists under the auspices of the Connecticut Department of Economic and Community Development, to submit a report outlining its progress to date, as well as how it will enhance the tech talent pipeline in the state to meet the increasing demands of the business community.

Introduction

Many of Connecticut companies lead their respective industries in research, development and innovation. Connecticut has both a highly educated population – the state ranks 3rd in the country for percentage of employees with advanced degrees[1] – and an extremely industrious workforce – Connecticut's working population ranks #4 in the United States for its productivity.[2] As former CareCentrix CEO, Eric Reimer, put it, "The employment market in Connecticut is filled with well-educated, talented, hard-working folks…"[3]

Connecticut is well positioned to thrive in a rapidly changing, technology-driven environment. Using key factors including technology and science workforce and technology concentration, the state ranks in the top ten on the Milken Institute's 2016 State Technology and Science Index.[4] Connecticut was also ranked 8th in the nation on the 2014 State New Economy Index, a measure which uses five categories of indicators, including knowledge jobs (high skilled IT professionals), digital economy and innovation capacity.[5]

In order to maintain this competitive edge, Connecticut companies depend on a pool of talented and well-trained employees, especially in the Science, Technology, Engineering and Mathematics (STEM)

[1] U.S. Census Bureau, Educational Attainment by State, 2013
[2] Bloomberg State Innovation Index, 2016
[3] Governor Dannel P. Malloy Press Release, June 28, 2012
[4] Milken Institute State Technology and Science Index, 2016
[5] The Information Technology and Innovation Foundation, The 2014 State New Economy Index, 2014

fields. Despite the positive rankings, workforce shortages have been particularly acute in the area of Information Technology (IT), which limits a company's ability to drive innovation and realize efficiencies in its business model. The centrality of IT talent to a company's success cannot be overemphasized as industries ranging from manufacturing to healthcare to insurance require technology talent to fully leverage the digital revolution.

The Technology Talent Advisory Committee, which is overseen by the Connecticut Department of Economic and Community Development (DECD), was created during the 2016 Legislative Session to help devise and execute strategies to reduce the number of unfilled jobs in IT in the state. By developing computer science-related programs and investing in emerging workers, we want to make our state as competitive for business as possible.

Technology Talent Advisory Committee Members

The Technology Talent Advisory Committee Members consist of members appointed by DECD Commissioner Catherine Smith. In order to ensure that the funding for tech talent meets the needs of critical industries in Connecticut, the Advisory Committee is comprised primarily of private sector business leaders, as well as representatives of public and private educational institutions. A full listing of members can be found in Appendix A. The Advisory Committee met three times during 2016 and is in the process of reviewing facts about the state, gathering ideas from key constituents and developing strategies for improvement.

Connecticut Labor Market Data

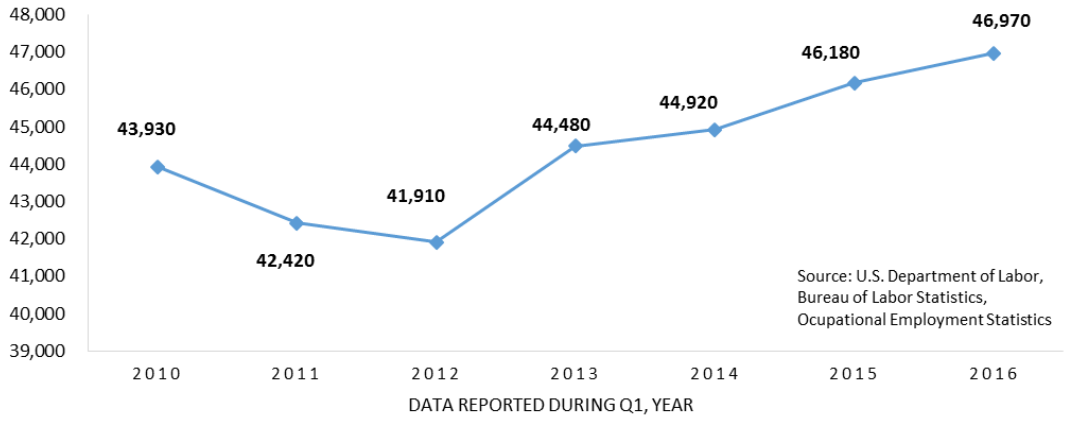
Current Employment

In order to have a better understanding of what Connecticut needs to do in order to grow the tech talent pipeline and produce qualified tech employees, it is critical to understand where the state currently stands. Using the Connecticut Department of Labor (DOL) and Occupational Employment and

Wages (OES) data, we were able to construe an estimate of the number of tech employees currently in the state. It should be noted that data collection of tech employees is an imperfect science. There is no standard definition of "tech employee" or "IT professional," which makes determining the number of the employees in this grouping difficult.

The DOL Computer and Mathematical Occupations category is comprised of 17 different occupational titles, including Computer and Information Research Scientists, Computer Programmers, Database Administrators, Information Security Analysts, Software Developers, and Statisticians.[6] The most recent data from the United States Department of Labor Bureau of Labor Statistics calculates that there were approximately 46,970 professionals that fall into the Computer and Mathematical Occupations category during Quarter 1, 2016, which is a 7% increase since Quarter 1, 2010 (see Graph 1 below for the trend in these occupations over time).[7] Proportionally, about 94% of this occupational employment falls under the Computer component of this group, with the remaining 6% being Mathematical occupations.

GRAPH 1:
COMPUTER AND MATHEMATICAL OCCUPATIONS PROFESSIONALS IN CONNECTICUT
Q1, 2010 - Q1, 2016



[6] This is a non-exhaustive list of occupational titles. A full list can be found in Exhibit B.
[7] U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics. Can be accessed at: https://www.bls.gov/oes/tables.htm. Note: this is the most recent employment data available.

Computer and Mathematical Occupations have also been slowly growing as a percentage relative to total employment in the state. In Quarter 1, 2010, Computer and Mathematical Occupations represented 2.357% of total employment in the state, whereas these occupations represented 2.830% of total employment in Quarter 1, 2016 (see Table 1 for additional details).

Table 1:
Computer and Mathematical Occupations as Percent of Total Employment

Quarter 1, Year	Computer & Mathematical Occupations (CM&O)	Total Employment	CM&O as % of Total Employment
2010	43,930	1,863,620	2.357%
2011	42,420	1,807,480	2.347%
2012	41,910	1,608,820	2.605%
2013	44,480	1,620,620	2.745%
2014	44,920	1,635,590	2.746%
2015	46,180	1,646,510	2.805%
2016	46,970	1,659,430	2.830%

Source: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics

Current Job Postings

Statewide job postings sourced from the Conference Board's Help Wanted OnLine (HWOL) data series has corresponding occupational breakdowns. Computer occupational job postings comprised between 95.2% and 96.9% of Computer and Mathematical Occupational job postings from October 2012 through November 2016. The HWOL data series measures the number of new, first-time online jobs and jobs reposted from the previous month for over 16,000 Internet job boards, corporate boards and smaller job sites that serve niche markets and smaller geographic areas.[8]

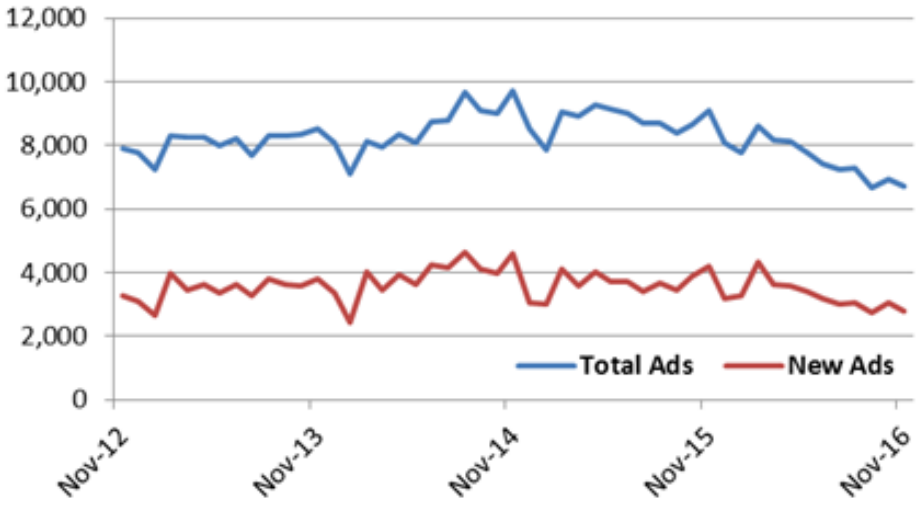
In November 2016 (the most recent complete month of available job postings), there were 6,693 postings for Computer and Mathematical Occupations in Connecticut. These 6,693 postings represent 9.6% of the total job postings in November across all industries throughout the state.

[8] Help Wanted OnLine, 2016. Can be accessed at: https://www.conference-board.org/data/helpwantedonline.cfm

Additionally, of the 23 industry classifications used by DOL and HWOL, Computer and Mathematical Occupations had the third highest number of job openings in the state during November. The only industries with higher numbers of job postings were Healthcare Practitioners and Technical Occupations and Sales and Related Occupations, with 10,912 and 8,748 postings, respectively.

The 6,693 job postings in November were the second lowest count since January 2011; September 2016 was the lowest with 6,677 postings (see Graph 2 below). This decrease in postings began in mid-2015 and corresponds with trends experienced by the economy overall. In the past year, Computer and Mathematical job postings in the state are down 26.4%, whereas postings for all industries in Connecticut are down 14.6%. However, two economists from the Federal Reserve Board have questioned the validity of the recent drop in the amount of HWOL advertising as an indicator of weakening labor demand, suggesting it may be the result of a change in job posting fees.[9]

Graph 2:
CT HWOL Computer and Mathematical Occupations
Seasonally Adjusted 2012-2016



[9] Cajner, Tomaz and David D. Ratner (2016). "A Cautionary Note on the Help Wanted Online Data," FEDS Notes. Washington: Board of Governors of the Federal Reserve System, June 23, 2016, http://dx.doi.org/10.17016/2380-7172.1795

As of November 2016, 10 specific occupations make up 89.1% of Computer Science and Mathematical occupational job postings in Connecticut (see Table 2 below). Those 10 occupations were all related to the Computer Science component of the occupational sector.

Table 2: Available Job Ads by Occupations

Available Job Ads - November 2016 Occupations	Total Ads	% Change From Nov. 2015	% of Total
Total Computer Science and Math. Occupations	**6,693**	**-26.4%**	**100.0%**
Computer Systems Analysts	982	-26.8%	14.7%
Software Developers, Applications	915	-23.0%	13.7%
Computer User Support Specialists	822	-32.3%	12.3%
Web Developers	821	-9.8%	12.3%
Information Technology Project Managers	605	-41.4%	9.0%
Network and Computer Systems Administrators	579	-27.8%	8.7%
Computer Systems Engineers/Architects	398	-15.9%	5.9%
Computer Programmers	336	-14.1%	5.0%
Software Quality Assurance Engineers and Testers	288	-23.4%	4.3%
Information Security Analysts	217	-28.6%	3.2%
All Other Comp. Sci. and Math. Occupations	730	-31.3	10.9%

Source: HWOL

The statewide industry distribution of Computer & Mathematical occupations shown in Table 3 (next page) highlights the wide array of industries that are seeking tech-oriented workers, including some that may not traditionally be viewed as sources of employment for jobseekers in that field.

Table 3: Available Job Ads by Industry

NAICS Code	Available Job Ads - November 2016 Industry Sector	Total Ads	% Change From Nov. 2015	% of Total
	Total All Industry Sectors	**6,693**	**-26.4%**	**100.0%**
54	Prof., Scientific, and Tech. Services	1,394	-11.9%	20.8%
56	Administrative and Support Services	969	-20.3%	14.5%
52	Finance and Insurance	471	-39.3%	7.0%
31	Manufacturing	351	-31.4%	5.2%
44	Retail Trade	312	0.6%	4.7%
51	Information	183	-40.4%	2.7%
62	Health Care and Social Assistance	177	-26.2%	2.6%
61	Educational Services	164	1.9%	2.5%
42	Wholesale Trade	134	-5.0%	2.0%
92	Public Administration	54	100.0%	0.8%
	All Other Industries	646	91.1%	9.7%
	Unavailable	1,838	-40.7%	27.5%

Source: HWOL

The Connecticut employers with the most job postings for Computer and Mathematical Occupations cover a wide variety of major industries in the state, including Insurance, Education, Healthcare and Finance. The Connecticut companies with the most job postings for Computer and Mathematical Occupations as of November 2016 are shown below (Table 4).

Table 4:
Connecticut Companies With the Most Job Postings for Computer and Mathematical Occupations - November 2016

Accenture	TEKsystems
United Technologies	Unitedhealth Group
Kforce Professional Staffing, Inc.	Apex Systems, Inc.
Robert Half International	Travelers Insurance
Deloitte	The Hartford
Yale University	ESPN
Belcan	ADP, Inc.
Monroe Staffing Services	Randstad
General Dynamics	Cognizant Technology Solutions
Sikorsky	Nigel Frank International

Source: HWOL

Computer Science Education in Connecticut

Building a successful tech talent pipeline starts with ensuring strong K-12 and higher education systems that promote computer science and problem solving skills. Without the classes to build early abilities and encourage early interest, students will struggle to enter tech-related careers later in life. The following section presents a brief overview on computer science education across the nation, as well as a closer look into computer science education in Connecticut.

On a national level, the United States is not doing enough to educate students in computer science or encourage them to enter into computer science-related professions. Approximately 90% of parents and guardians would like to see their child learn computer science skills in primary and/or secondary school, but, at present, only 40% of K-12 schools nationwide teach computer programming.[10] With ever-tightening budgets in K-12 education, computer science courses are often the first to be cut from curricula. The outlook is brighter in higher education. The United States is home to some of the top computer science programs in the country, including the Massachusetts Institute of Technology, Stanford University and Carnegie Mellon University.[11] However, these programs are often small and limited to the proficiency and availability of faculty; only 42,969 computer science students graduated into the workforce in 2015, but there were nearly 494,000 open computing jobs nationwide.[12]

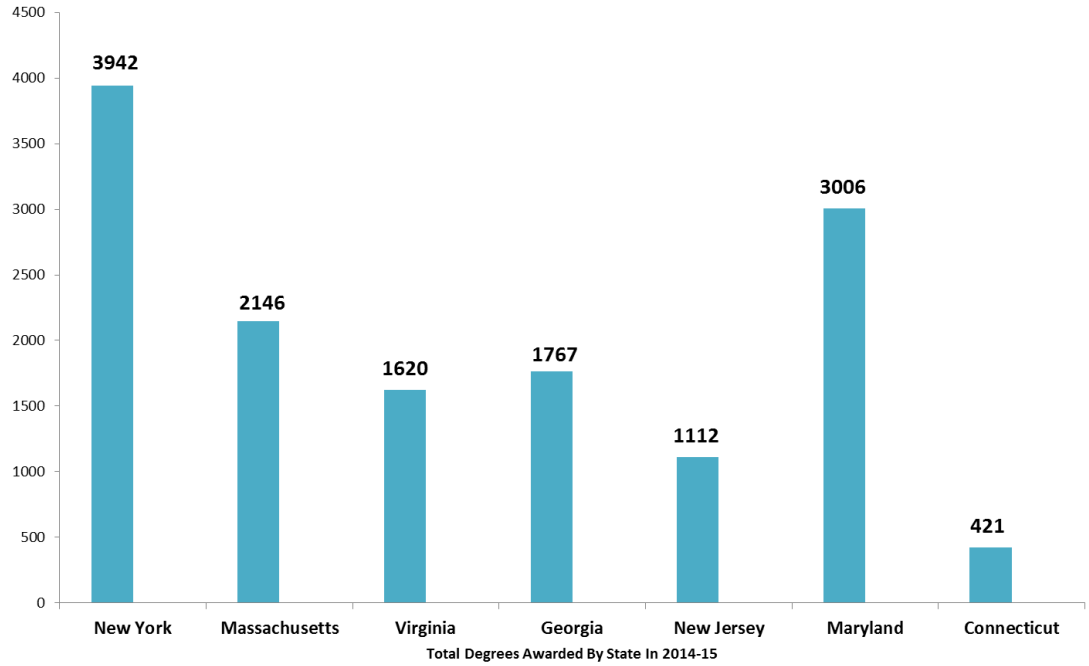
Though Connecticut has some of the strongest primary and secondary schools in the country, the state is not currently doing enough in K-12 education to ensure the next generation of employees have the practical skills needed to fill tech-related jobs. Connecticut does not yet have official computer science standards publicly available across K-12 education, it does not mandate computer science as a high school graduation requirement for public schools and does not yet have a clear path to certification

[10] Code.org, 2016. Can be accessed at: https://code.org/promote
[11] QS World University Rankings, 2016. Can be accessed at: http://www.topuniversities.com/university-rankings-articles/university-subject-rankings/top-computer-science-schools-2016
[12] Code.org, 2016. Can be accessed at: https://code.org/promote

for computer science teachers. As a result, too few students are gaining and holding interest in computer science. In 2016, only 939 high school students in Connecticut took the Advanced Placement (AP) Computer Science exam, which only represents 3.4% of the total number of Connecticut students taking AP exams. Of those 939 students, only 216 were female; only 76 students were Hispanic or Latino; and only 31 students were Black.[13] This demonstrates that too few students are gaining interest in advanced computer science studies prior to attending an institution of higher education, as well as a clear need for increased diversity in K-12 computer science education in Connecticut.

The lack of interest and capacity in computer science education does not end with K-12 education. Connecticut colleges and universities lag behind other east coast states in computer sciences degrees awarded annually. Graph 3 below illustrates the number of computer science degrees awarded in 2014-2015 for seven east coast states.

Graph 3:
Total Bachelor's Degrees Awarded in 2014-15
in Computer Science
Source: IPEDS



[13] Code.org, 2016. Can be accessed at: https://code.org/advocacy/state-facts/CT.pdf

Only 421 Connecticut students graduated with a Bachelor's degree in Computer Science during the 2014-2015 school year, which is 1.33% of the total number of students enrolled in a Connecticut institution of higher education.[14] For comparison, during the same year, 2.08% of New York's enrolled students, 2.86% of Massachusetts' enrolled students, and 6.52% of Maryland's enrolled students graduated with a Bachelor's degree in Computer Science. Our current education systems are not only not keeping up with the demand from Connecticut employers, but they are also struggling to compete with other states in close geographical proximity.

Notes from the Field

In order to better understand the current issues in Connecticut's tech talent pipeline and workforce, we interviewed several key stakeholders in the field, including representatives from the Connecticut Technology Council, Independent Software, The Connecticut Conference of Independent Colleges, Yale Office of Federal Relations, and the Business Council of Fairfield County. From these conversations, several gaps became apparent: (1) the job cycle gap, (2) the communication gap, and (3) the skills gap.

The job cycle gap describes the simultaneous misperceptions between emerging talent and Connecticut companies looking to hire this talent. Well-educated graduates from Connecticut institutions of higher education hold the belief that there are no solid tech jobs, job openings or companies within the state, so graduating students look for jobs outside state borders. At the same time, Connecticut companies are often under the impression there are insufficient numbers of qualified applicants for tech positions, so they hire outside of the state. Often, by the very nature of a tech-related position, a person can work remotely, without ever needing to relocate to Connecticut. These two misperceptions perpetuate an important problem: graduating students do not believe there are

[14] Integrated Postsecondary Education Data System (IPEDS), 2016. Can be accessed at: https://nces.ed.gov/ipeds/datacenter/login.aspx?gotoReportId=1

jobs available and employers do not believe there are graduating students available. As a result, graduates leave the state and employers either hire remotely or leave jobs unfilled.

A breakdown in communication also exists among stakeholders, specifically employers, graduates and universities. On the whole, there is a lack of adequate advertising at Connecticut colleges and universities for job fairs and job postings. Though big employers often have the technical knowledge and human capital to go to job fairs, send job positing to career services offices, and spend time recruiting talented workers, many small- and mid-sized businesses struggle to interact with students. They're less likely to recruit talented interns or employees and are unable to create a presence for themselves in student communities. Without formalized partnerships between universities and employers, students are more likely to apply and move out of state in pursuit of a tech-related job.

Finally, many companies have (anecdotally) stressed the misalignment between higher education curricula and the practical skills needed within the workplace. Rather than learning the skills that will be needed in a tech-related job, such as practical coding skills, students appear to be learning more of the theory and principles behind computer science and coding languages. Though theoretical skills are undoubtedly important, students are graduating ill-prepared to enter entry-level positions. Balancing these two necessary, but independently insufficient, skills will be integral in creating a thriving and productive tech talent pipeline.

Pilot Programs

The overall charge of the Technology Talent Advisory Committee is to identify the greatest gaps in tech talent in Connecticut and make strategic investments in programs to help fill in these gaps. Legislation suggests that the Technology Talent Advisory Committee develop programs that help produce tech talent in three broad areas: (1) marketing campaigns to attract tech talent, (2) student loan deferral or forgiveness programs for students that choose to start businesses in the state, and (3) training, apprenticeship and gap-year initiatives.

Of the thirteen members of the Technology Talent Advisory Committee, nine of them are private industry leaders. As such, the majority of the Advisory Committee's initial activities have included a strategic brainstorming session to establish our goals and priorities. Early on in these conversations, it became clear that most of the suggested goals of this funding fell into three broad categories: creating tech talent, retaining tech talent and attracting tech talent. The Advisory Committee was able to generate an extraordinary number of strategies to build the tech talent pipeline, including increasing the number of graduates in computer science programs at all levels of education, provide training to emerging talent (i.e., graduating students) for practical skills required by employers, making technology a more desirable field for young people to find appealing, ensuring Connecticut has enough teachers with appropriate computer science knowledge and better engage the private sector with educational organizations and their graduates. Ultimately, the Advisory Committee was asked to prioritize these strategies. The following concepts were identified as critical areas of need for the state:[15]

- Speeding up the certification processes for secondary computer science teachers, specifically teachers in grades 9-12
- Providing credentialing opportunities for cross-endorsement instructors (teacher that can teach multiple subjects)
- Scale up existing boot camp style programs, which give the final prep required to be successful in the workplace
- Better connect emerging talent to jobs
- State supported internships for students
- Focusing on improved curriculum to ensure students are building critical thinking and problem solving skills early on that allow them to enter in technology-related professions

[15] These ideas were chosen as the priorities of the Advisory Committee during the brainstorming sessions, but are not listed in any particular order

However, we recognize that this is just a small sample of the business leaders across the state. To better test these assumptions, the Technology Talent Advisory Committee is currently working to develop a survey to send to employers across the state. This survey, which is in the process of being created in with the collaboration of the Connecticut Technology Council and the Connecticut Economic Resource Center, will ask targeted questions about tech hiring needs of employers across all key industries. The results of this survey will ultimately allow us to determine the greatest gaps in tech talent and where we can begin to make meaningful investments. Though we are very eager to begin investing in a tech talent pipeline, we want to ensure we are making strategic, evidence-based decisions with public money before proceeding.

Upcoming Activities

Though the Technology Talent Advisory Committee is actively working to create this survey, we also have several additional activities on our radar: planning the 2017 Connecticut Computer Science Summit and submitting a Computer Science for All grant application to the National Science Foundation.

2017 Connecticut Computer Science Summit

Because there are a growing number of committees, commissions and working groups that currently exist to research the present computer science landscape in the state of Connecticut and formulate strategic plans to strengthen the tech talent pipeline, we have decided to come together to share ideas, objectives and strategies. Some of these groups include the Computer Science Advisory Group (State Department of Education), Technology Talent Advisory Committee (Department of Economic and Community Development), and the Connecticut Commission for Education Technology, as well as the presence of additional informal groups in districts around the state. In order to avoid duplicative efforts to increase computer science education in Connecticut

classrooms and build a tech talent pipeline, we are in the process of planning a meeting with the expressed purpose of developing a common strategic plan, with implementation strategies.

National Science Foundation Computer Science for All: Researcher-Practitioner Partnerships

We are in the process of pursuing a discretionary grant opportunity from the National Science Foundation, which aims to build researcher-practitioner partnerships (RPPs) that foster research and development needed to bring computer science and computational skilling education to all schools. The following is a brief description directly from the National Science Foundation:

> This program aims to provide *all* U.S. students the opportunity to participate in computer science (CS) and computational thinking (CT) education in their schools at the K-12 levels. With this solicitation, the National Science Foundation (NSF) focuses on researcher-practitioner partnerships (RPPs) that foster the research and development needed to bring CS/CT to all schools. Specifically, this solicitation aims to provide high school teachers with the preparation, professional development (PD) and ongoing support that they need to teach rigorous computer science courses, and K-8 teachers with the instructional materials and preparation they need to integrate CS/CT into their teaching.[16]

The Technology Talent Advisory Committee has decided to work with the State Department of Education and the University of Connecticut to pursue this grant, specifically the funding aimed at providing high schools teachers with the professional supports needed to teach computer science classes. Though still in the early stages of the application, the group will ensure the grant is submitted by its deadline, February, 28, 2017.

Timeline and Measures for Implementation

The Technology Talent Advisory Committee is specifically charged with implementing programs designed to double the number of calculated tech employees by January 1, 2026. Based on the calculations from DOL, Connecticut will need to employ 93,940 employees in Mathematical and Science Occupations by the year 2026 in order to reach this goal. Once we have completed our initial strategy,

[16] National Science Foundation, Computer Science for All. Can be accessed at: https://www.nsf.gov/pubs/2017/nsf17525/nsf17525.htm

the Advisory Committee will be in a better position to determine what will be required to reach this goal.

Though the Advisory Committee has much of the data it needs to better understand the current computer science landscape, we are still missing critical demand information from employers. Without this data, we cannot be certain that the programs we implement are directly providing talented, qualified employees for these companies. As such, until we have a better sense of what employers need, we cannot begin to fund and plan for programs that will increase the number of tech employees.

Appendix A

Technology Talent Advisory Committee Members

Per the legislation, members should include representative(s) of The University of Connecticut, the Board of Regents for Higher Education, independent institutions of higher education and private industry.

Chair: Catherine Smith, Commissioner Dept. of Economic and Community Development	Pedro Bermudez, Co-founder Revisionist Films
Commissioner Dianna Wentzell Dept. of Education	Dr. Ken Colwell, Dean of School of Business Central Connecticut State University (appointed by the Board of Regents)
Kate Emery, CEO The Walker Group	Josh Geballe, CEO Core Informatics
Lisa Jacobi, Senior VP Human Resources COCC	Julio Mansilla, Outreach Manager A100, Independent Software
Bill Moschella, CEO Evariant	Venkata Natarajan, CIO Prudential
Dr. Alex Schwarzmann, Computer Sciences Dept Chair The University of Connecticut, Storrs	Mike Silverstrini, President, Co-founder, Director Greenskies
Dan Viens, Senior VP Global Human Resources FactSet Research Systems, Inc.	Jen Widness, President The Connecticut Coalition of Independent Colleges

Appendix B

Occupation Titles Used in Determining Computer and Mathematical Occupations Industry Cluster[17]

Actuaries

Computer and Information Research Scientists

Computer Network Architects

Computer Network Support Specialists

Computer Occupations, All Other

Computer Programmers

Computer Systems Analysts

Computer User Support Specialists

Database Administrators

Information Security Analysts

Mathematical Science Occupations, All Other

Network and Computer Systems Administrators

Operations Research Analysts

Software Developers, Applications

Software Developers, Systems Software

Statisticians

Web Developers

[17] Connecticut Department of Labor, July 2016. Can be accessed at: http://www1.ctdol.state.ct.us/lmi/wages/statewide2016.asp#computer